PCT/AU03/01180

10/527613

REC'D 30 SEP 2003

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I, JONNE YABSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2002951329 for a patent by NEPEAN ENGINEERING PTY LTD as filed on 11 September 2002.

WITNESS my hand this
Nineteenth day of September 2003

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PRIORITY DOCUMENT
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AUSTRALIA

PATENTS ACT 1990

PROVISIONAL SPECIFICATION

FOR THE INVENTION ENTITLED:

"A MIXING APPARATUS FOR CONCRETE"

The invention is described in the following statement:-

TITLE: A MIXING APPARATUS FOR CONCRETE

FIELD OF THE INVENTION

The present invention relates to concrete mixers and in particular to truck mountable concrete mixers. It has been developed primarily for use as a concrete mixer mountable on a truck chassis to allow weigh batched concrete ingredients to be mixed and adjusted for slump at a batch plant prior to the mixer's departure. Whilst enroute, the mixer drum is slowly rotated in order to prevent the wet concrete from segregating. It will be appreciated that transit mixers are not limited to the above field and are sometimes used to mix other materials.

BACKGROUND TO THE INVENTION

The following discussion of the prior art is intended to present the invention in an appropriate technical context and to allow its significance to be properly appreciated. Unless clearly indicated to the contrary, however, reference to any prior art in this specification should not be construed as an admission that such art is widely known or forms part of common general knowledge in the field.

Known concrete transit mixers are typically constructed by mounting a concrete mixing assembly to a truck chassis. The mixing assembly includes a concrete mixing drum rotatably supported by front and rear drum support pedestals. These pedestals are fixedly connected to a rectilinear bracket, which is in turn used to secure the assembly to the truck chassis.

Most transit mixers include an open mouthed mixing drum, typically inclined rearwardly at an angle of approximately 14 degrees to the horizontal. One or more generally helical mixing blades are mounted to the interior surface of the drum. Each blade is similar to an Archimedean screw, except that the pitch and height of the blade often varies along the length of the drum. Normally, the blades have a close pitch and relatively low height near the mouth of the drum and develop progressively to a relatively large pitch and greater height as the drum diameter increases toward the closed front end adjacent the drum head. The drum is usually rotatably driven about its inclined axis by an hydraulic motor or internal combustion engine connected to the drum head.

When dry batch ingredients such as sand, stone and cement are fed into the mixer through the open mouth with a suitable quantity of water, the helical mixing blades tend to wind the material progressively forwardly toward the drum head. During this movement, in prior art transit mixers the spiral blades propel the ingredients downward toward the drum head. As the material cannot proceed any further, it accumulates and builds up toward an upper region of the drum head and then folds over itself and through the force of extrusion is driven back toward the rear opening. As the mixing volume is usually about 60% of the total drum volume, the material moving toward the opening slides downward and becomes re-engaged with the lower blades and is once again wound downward toward the drum head. The continuation of this action at about sixteen revolutions per minute for many minutes finally achieves mix uniformity and provides the slump required by the customer.

The mixing time, or number of revolutions of the drum required to mix the ingredients uniformly, is dependent on a number of factors including:-

(1) The mixing speed;

(2) The shape and volume of the mixing drum; and

(3) The design of the mixing blades.

In Australia, any truck mounted mixer must comply with Australian Standard AS1379-1997 in terms of uniformity of mixing. This test is generally referred to as the "mixing efficiency test". It has been found that if a truck mounted mixer is to achieve the required degree of uniformity in mixing, the blades must not only induce a rotating motion of the concrete mass parallel to the rotational axis of the drum, but perhaps even more importantly, an overall end to end mixing action so that the concrete is uniform throughout its mass.

While conventional transit mixers can achieve the requirements of AS1379-1997, it is commonly accepted that their mixing efficiency is overshadowed by that of central drum mixers which achieve the required uniformity within around a third to a quarter of the time. It is also well known that transit mixers require a higher proportion of cement to be added to their mixes in order to achieve the concrete strength usually obtainable by formulations mixed in central drum mixers.

The main explanation for the superior performance lies in the following characteristics of the central drum mixer:-

(1) Shape and larger diameter of the mixing drum;

(2) Larger internal drum volume (typically around 15.4m^3 for a 6m load); and

(3) Mixing blade design adapted to lift material from one side of the drum and discharge in a criss-cross cascading action to the opposite side.

The concrete cascading down on itself induces high impact and frictional forces. According to Portland cement experts, these forces are capable of crushing residual cement agglomerations and releasing the entrapped cementitious material for hydration. This leads to central drum mixers requiring a lower proportion of cement in their mixes than would be required by transit mixers to achieve the same ultimate concrete strength. There is a long felt need to provide a truck mounted concrete mixer with mixing efficiency and performance comparable with those of a central drum mixer.

As previously mentioned, both Portland cement experts and indeed most authorities recognise the superior mixing efficiency and reduced mixing time in 6m^3 stationary drum mixers compared to 6m^3 transit mixers. Also, many authorities actually specify the use of large central mixers for concrete to be used in critical mass concrete structures.

Portland cement experts believe that when dry cement powder comes into contact with water there is a natural tendency for cement agglomerations to form. The common use of chemical additives also assists in the creation of myriads of cocoons, which although entrapping thousands of micron sized cement particles, are nevertheless invisible due to the gentle folding action of prior art transit mixers. These cocoons float around within the concrete mass and never become hydrated. By contrast, the turbulence and friction created in a central drum mixer crushes the agglomerations, releasing the entrapped cement for hydration and thereby resulting in higher strengths and shorter mixing times in central mixers.

It is an object of the invention to overcome or ameliorate one or more of the deficiencies of the prior art, or at least to provide a useful alternative.

SUMMARY OF THE INVENTION

Accordingly, the invention provides a mixing apparatus for concrete including:

a mixing drum supported for rotation about a longitudinal axis, the drum having a closed end defined by a drum head and an open end to receive batch materials to be mixed;

a first, generally helical, mixing blade disposed within the drum; and

a second blade extending from the mixing blade toward the drum head, the second blade being adapted upon mixing rotation of the drum to fill with material from the bottom of the drum near the drum head and to elevate the material for cascading discharge toward the open end of the drum and downward toward the area of largest diameter of the drum.

Preferably, the second blade intersects with the mixing blade, and the height of the second blade is greater than the height of the adjoining mixing blade at the point of intersection, thereby to define a spillway formation at the intersection. More preferably, the second blade includes a projecting guide wall extending above the mixing blade toward the open end of the drum. Even more preferably, a spillway lip extends from adjacent the second blade along an upper edge of the mixing blade, to direct material flowing across the spillway toward the open end of the drum.

Preferably, the second blade intersects substantially perpendicularly with the mixing blade. Preferably, a flange extends from the drum head end of the second blade substantially parallel to the mixing blade, thereby to promote discharge of material on the drum head side of the of the second blade upon rotation of the drum in a discharge direction.

In a preferred embodiment, the mixing blade is tapered, progressively reducing in height from near the second blade to near the drum head. More preferably, the height of the mixing blade near the drum head is around half of its height immediately adjacent the second blade.

In another embodiment, the mixing blade extends from near the open end of the drum and terminates at the second blade. In this embodiment, the apparatus preferably includes a discharge blade extending from near the drum head and terminating near the

second blade. Preferably, the height of the discharge blade is around half the height of the mixing blade.

Preferably, the apparatus includes a supplementary blade extending substantially perpendicularly from the mixing blade at a position closer to the open end of the drum, the supplementary blade being adapted upon mixing rotation of the drum to fill with material from the bottom of the drum and to elevate the material for cascading discharge toward the open end of the drum. More preferably, the height of the supplementary blade is greater than the height of the adjoining mixing blade, thereby defining a supplementary spillway formation at the point of intersection. Even more preferably, the supplementary blade includes a supplementary projecting guide wall extending above the mixing blade toward the open end of the drum.

Preferably, the apparatus includes a pair of the mixing blades, each including a respective second blade. More preferably, each mixing blade includes a drainage hole adjacent to its respective second blade.

Preferably, the mixing drum is supported on a truck for rotation about a longitudinal axis inclined at between 10° and 20° to the horizontal.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a cut-away perspective view of a mixing apparatus according to a first embodiment of the invention;

Figure 2 is an enlarged cutaway view showing the drum head end of a mixing apparatus according to a second embodiment of the invention; and

Figure 3 is an enlarged cutaway view similar to Figure 2, showing a third embodiment of the invention.

PREFERRED EMBODIMENTS OF THE INVENTION

Referring to the drawings, the concrete mixing apparatus includes a mixing drum 1 supported for rotation about a longitudinal axis 2. The drum has a closed end defined by a drum head 3 and an open end 4 to receive batch materials to be mixed. A pair of generally helical mixing blades 5 (only one mixing blade is shown for ease of illustration) are disposed within the drum 1. A second blade 6 extends from each mixing blade 5 toward the drum head 3, such that upon mixing rotation of the drum the second blades fill with material from the bottom of the drum near the drum head and elevate the material for cascading discharge toward the open end of the drum and downward toward the area of largest diameter of the drum.

Each second blade 6 extends substantially perpendicularly from its respective mixing blade 5 at a height greater than that of the adjoining mixing blade. This height difference defines a spillway formation 7 above the mixing blade, through which material flows in the direction indicated by arrow 7A. Each second blade 6 further includes a projecting guide wall 8 extending above the mixing blade toward the open end 4 of the drum. A spillway lip 9 also extends from adjacent the second blade along an upper edge of the mixing blade 5. Together, the guide wall 8 and spillway lip 9 direct material flowing across the spillway 7 toward the open end of the drum.

A flange 10 extends from the drum head end of each second blade 6 substantially parallel to its respective mixing blade 5, thereby to promote discharge of material on the drum head side of the second blades upon discharge rotation of the drum.

Referring now to the second and third embodiments of the invention as illustrated in Figures 2 and 3 respectively, a supplementary blade 11 extends substantially

perpendicularly from each mixing blade 5 at a position closer to the open end of the drum. Each supplementary blade 11 is adapted upon mixing rotation of the drum to fill with material from the bottom of the drum and to elevate the material for cascading discharge toward the open end of the drum.

Like the second blades, each supplementary blade 11 extends from its respective mixing blade at a height greater than that of the adjoining mixing blade. This height difference defines a supplementary spillway 12 above the mixing blade, similarly adapted to direct flow as indicated by arrow 12A. Again, each supplementary blade includes a projecting guide wall 13 extending above the mixing blade toward the open end of the drum. This guide wall directs material flowing over the spillway toward the rear of the drum.

Each supplementary blade 11 is located such that material passing over the associated spillway 12 is directed to cascade through the portion of the mixing drum having the greatest diameter. In this way, the impact and frictional forces induced by the cascading material are maximised, thereby disintegrating more of the cement agglomerations and releasing more cementitious material for hydration.

Each mixing blade includes a drainage hole 14 adjacent its respective second blade. This hole allows material wedged in the region between the second blade and the drum head to be released. Also, in this embodiment as illustrated in Figure 2, the mixing blades each taper in height from near the adjoining second blade to near the drum head, such that the height of the mixing blade near the drum head is around half its height near the second blade. However, in other embodiments as illustrated in Figure 3, each mixing blade extends from near the open end of the drum and terminates at its respective

second blade. In these other embodiments, a pair of discharge blades 15, each around half the height of the mixing blades, extends from near the drum head to terminate near a respective one of the second blades.

In the illustrated embodiments, the mixing drum 1 has a maximum diameter of around 2450mm compared to a 2300mm maximum diameter in prior art $6m^3$ concrete transit mixers. This increased diameter results in the cascading concrete falling through a greater distance, thereby to increase the forces imparted when impacting on the underlying concrete. Along with a reduced mixing blade height compared to prior art mixers, the increased diameter also contributes to providing additional space to facilitate the end-to-end folding action of the concrete.

Generally, the mixing drum is supported on a truck (not shown) for rotation about a longitudinal axis inclined at between 10° and 20° to the horizontal. The methods of supporting, driving and controlling the rotation of the drum are conventional, and being well understood by those skilled in the art, need not be described in further detail.

It will be appreciated that the illustrated mixing apparatus lifts wet concrete adjacent the drum head and discharges the concrete from near the top of the drum to induce a cascading action similar to that seen in central drum mixers.

It has been found in practice that the invention as described produces faster mixing times, higher mixing efficiencies, requires a lower proportion of cement, and produces a stronger concrete formulation with respect to conventional transit mixers of comparable capacity. Without wishing to constrain the efficacy of the invention to any particular

theoretical exposition, it is believed that these advantages are conferred as a result of the cascading motion induced by the reverse and supplementary blades emulating in some respects the operation of a central drum mixer. In any event, the performance enhancements represent both practical and commercially significant improvements over the prior art.

Although the invention has been described with reference to specific examples, it will be appreciated by those skilled in the art that it may be embodied in many other forms.

DATED this 11th Day of September, 2002

NEPEAN ENGINEERING PTY LTD

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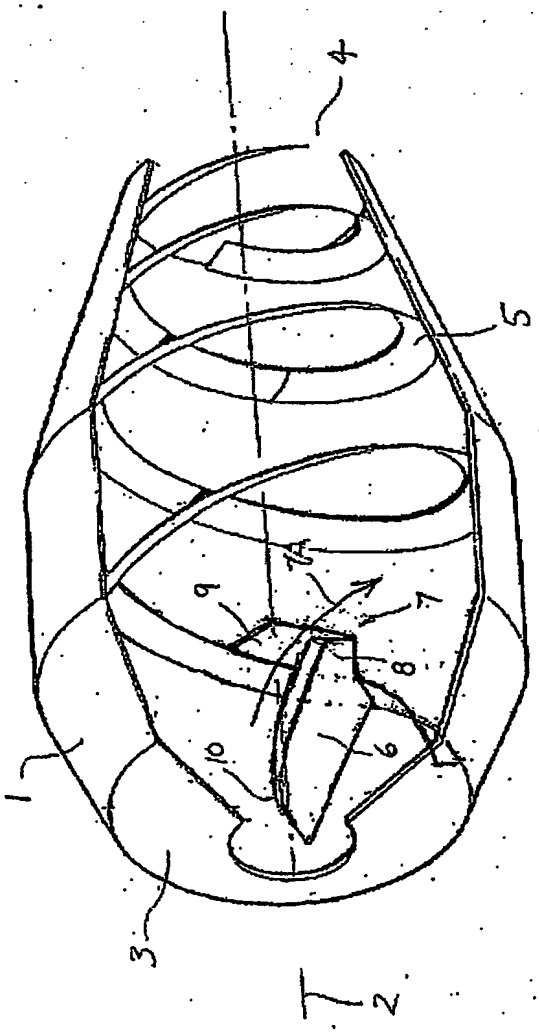

FIG. 1

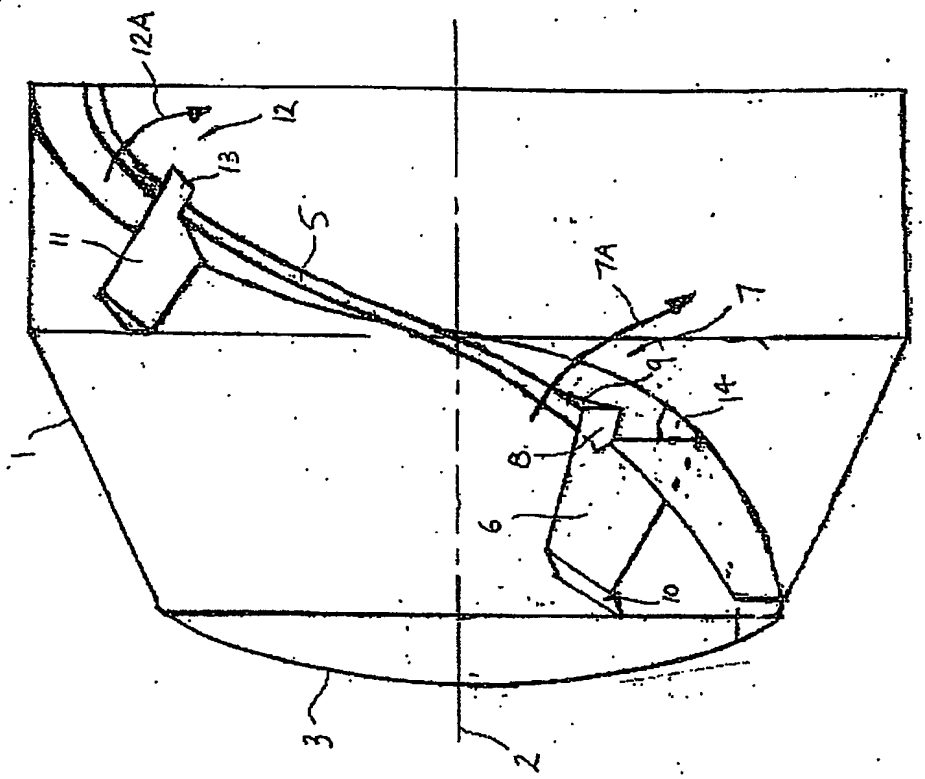

FIG. 2

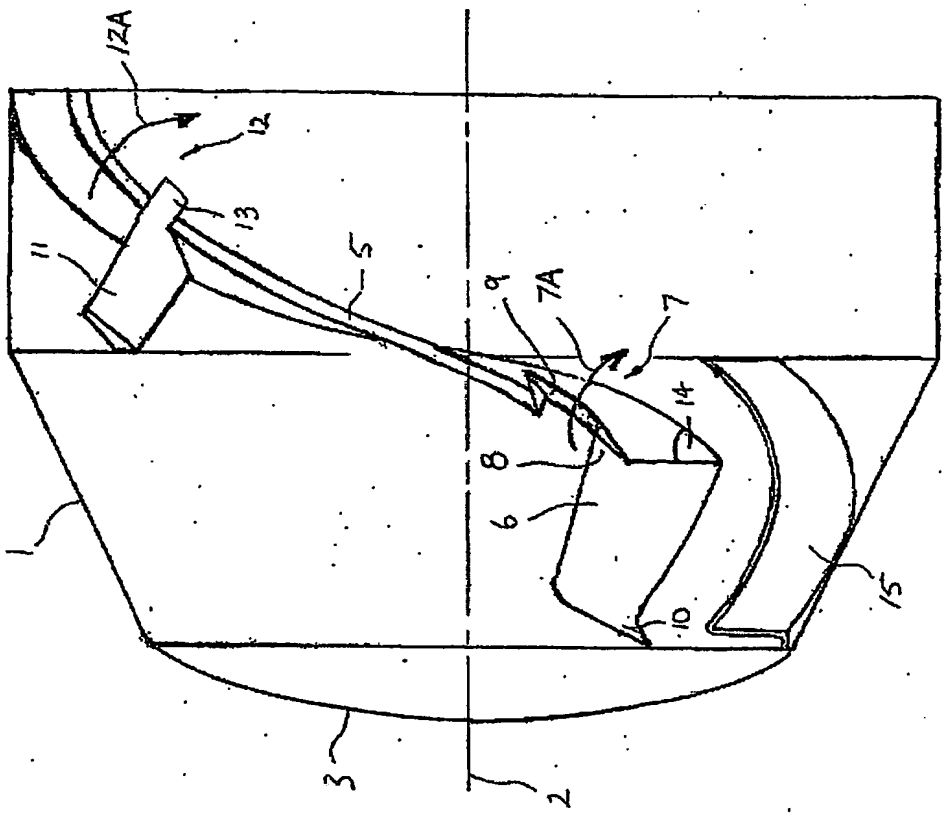

FIG. 3